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REVALUATION OF THE MISSOURI-SOURIS
DEVELOPMENT AREA WATER POLLUTION
INVESTIGATIONS

PUBLIC HEALTH SERVICE
KANSAS CITY, MISSOURI

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17b. Identifiers/Open-Ended Terms <table border="0"> <tr> <td>Souris River</td> <td>North Dakota</td> </tr> <tr> <td>Sheyenne River</td> <td>Garrison Reservoir</td> </tr> <tr> <td>Red River</td> <td>Public health</td> </tr> <tr> <td>James River</td> <td>*Water flow</td> </tr> <tr> <td>Wild Rice River</td> <td>*Water pollution control</td> </tr> <tr> <td>Missouri River</td> <td>*Land reclamation</td> </tr> <tr> <td></td> <td>Irrigation</td> </tr> <tr> <td></td> <td>Water supply</td> </tr> </table>				Souris River	North Dakota	Sheyenne River	Garrison Reservoir	Red River	Public health	James River	*Water flow	Wild Rice River	*Water pollution control	Missouri River	*Land reclamation		Irrigation		Water supply
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**Revaluation of the Missouri-Souris
Development Area Water Pollution Investigations.**

**Ralph Porges
Senior Sanitary Engineer
Public Health Service**

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Development Area Water Pollution Investigations.

Introduction

Initial proposals for development of land and water resources in the Souris, Sheyenne, Red, and James River Basins envisaged primary diversion of Missouri River water from Fort Peck Reservoir to Medicine Lake Reservoir to the Souris River Basin near the vicinity of Crosby, North Dakota and a supplemental and alternate diversion from Garrison Reservoir by pumping over the divide to the headwaters of the James and Sheyenne Rivers and then by canal to the Souris River. Recent investigations and surveys by the Bureau of Reclamation have indicated that over 1,000,000 acres of irrigable land in North Dakota may be more efficiently and economically served by diversion from Garrison Reservoir than from Fort Peck as originally conceived.

The Bureau of Reclamation recognized the importance of public health interests in providing for maximum water utilization and consulted with the respective State Health Departments and the Public Health Service. This led to an agreement regarding "Joint Program for Public Health Investigations of the Souris-Red River of the North Basin" dated

March 20, 1950 and a similar agreement dated January 9, 1951 concerning the James River Basin. Subsequently, field studies and evaluations were made culminating in a "Missouri-Souris Development Area Water Pollution Investigation" Report dated November 1951, and a "James River Drainage Basin" Report dated April 1952, issued as cooperative State-Federal reports on water pollution jointly by the Health Departments of the several States concerned and the Missouri Drainage Basin Office of the Public Health Service, and in cooperation with the Bureau of Reclamation. These reports evaluated the probable effect of the then proposed water development plan on matters of public health, particularly water supplies, sewage and waste disposal, and stream sanitation. Included were recommendations for adequate sewage and waste treatment and desirable minimum low flows for improvement of stream sanitation.

In view of contemplated revisions in flow routing, the Bureau of Reclamation has requested that the Public Health Service, in cooperation with the respective State Health Departments, re-evaluate the public health interests in the development area under consideration. Of particular concern to the Bureau of Reclamation is the revaluation of stream pollution and pollution abatement in the following stream reaches:

Souris River from Minot to Canadian Boundary,
Sheyenne River from Harvey to its mouth,
Red River from mouth of Sheyenne to Canadian Boundary,
James River from vicinity of Fessenden to Aberdeen, S. D.,
Wild Rice River from its headwaters to its mouth.

Garrison Diversion Unit

The Garrison Diversion Unit, with possibilities of becoming the largest single reclamation irrigation project in the United States, proposes to convey water, pumping when necessary, from Garrison Reservoir into Snake Creek Reservoir. From this reservoir, McClusky Canal would convey water into Lonetree Reservoir in the upper reaches of the Sheyenne River. This regulating reservoir will be the focal point for main canals servicing major water use areas. Velva Canal will run northwesterly to the Souris River Basin; the East Souris Canal, picking up mainly return flows, will service land east of the Souris and run southeasterly to the north fork of the Sheyenne River.

Devils Lake Canal will take off northeasterly from Lonetree Reservoir to service land in the Harvey-Maddock Area and, by a short feeder canal, restore Devils Lake. A feeder canal will connect Stump Lake and Devils Lake and an outlet canal from Stump Lake will provide for flow back to the Sheyenne River.

The Coleharbor Area will be serviced by pumping from Snake Creek Reservoir. Sykeston Canal will start from McClusky Canal above its drop into Lonetree Reservoir and extend easterly about 65 miles.

New Rockford Canal will head southeasterly from Lonetree Reservoir to service the New Rockford, Warwick-McVile, and Baldhill Areas and may also supplement flows in the James River

which will be regulated by Jamestown Dam. Cooperstown and Baldhill Canals, extensions of the New Rockford Canal, will serve the Baldhill Area.

Irrigable lands in the Jamestown Area will be serviced by pumping plants and a system of lateral canals. The Oakes Pumping Plant will service 108,000 acres in North Dakota and South Dakota.

Potential irrigation development in the Red River Valley is enormous, possibly 2,000,000 acres. Development of these areas are anticipated but will depend upon demand; flow and routing adjustments must eventually be considered for these projects. However, the Bureau of Reclamation believes there will be between 200,000 and 400,000 acre-feet of byproduct water annually for release during low flow periods to the Red River for benefit to industrial development and for stream sanitation.

The average minimum monthly flows based upon development of the Garrison Diversion Unit as determined by the Bureau of Reclamation is shown in table 1. Flows are specified by months for various locations on the Souris, Sheyenne, Red, Wild Rice, and James Rivers.

Sewage Treatment

Extremely pertinent to this review is a brief discussion of sewage treatment and treatment trends in the area under consideration. Sewage treatment generally has been considered for

Table 1.

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

Minimum Average Monthly Flows $1\frac{1}{2}$												Unit: CFS
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Velva Towner Dam 357 $2\frac{1}{2}$	1 31 20	1 31 20	2 32 20	12 52 20	7 254 20	2 289 20	1 161 20	1 181 20	1 151 20	1 101 20	1 41 20	1 41 20
Harvey Sheyenne Cooperstown Valley City Lisbon West Fargo	7 42 93 98 98 106	7 42 91 98 98 104	7 42 94 96 96 103	16 775 953 492 492 563	18 163 332 222 222 257	26 170 370 224 224 241	35 227 491 210 210 224	39 255 529 325 325 332	33 212 436 250 250 258	22 942 1095 1150 1150 1160	9 597 663 940 940 952	9 57 123 130 130 137
Fargo $3\frac{1}{2}$ Grand Forks	124 145	123 119	161 113	RED RIVER OF THE NORTH 755 1429	313 622	317 440	321 395	441 464	349 361	1221 1223	976 994	164 171
Forman	18	18	18	WILD RICE RIVER 28	48	73	97	109	91	61	24	24
Fessenden $4\frac{1}{2}$ New Rockford Jamestown Oakes	6 8 27 27	6 8 29 28	6 8 32 32	JAMES RIVER 8 10 50 50	837 5 323 311	695 7 282 242	1595 9 260 238	1144 10 494 445	1071 9 480 466	110 6 117 117	8 2 39 39	8 10 38 38

$1\frac{1}{2}$ Based on assumed complete development of Garrison Diversion Unit.
 $2\frac{1}{2}$ Below Dam 357
 $3\frac{1}{2}$ Below mouth of Sheyenne River.
 $4\frac{1}{2}$ Includes irrigation season flows in New Rockford Canal.

our purposes as grouped in two broad catagories; primary treatment and secondary treatment. Primary treatment may be considered as removing 35% of the oxygen-consuming material and secondary treatment 75% of the oxygen-demanding substances. Of course, intermediate treatment occasionally is encountered, as is a higher degree of treatment sometimes called tertiary. Future treatment considerations may call, not without reason, for 45% treatment (primary) and 85% treatment (secondary). One form of a treatment that removes a waste entirely from a stream might be called complete or total treatment. This has occurred where wastes are lagooned and no effluent, or only one that is highly stable, is permitted to reach flowing bodies of water.

The State Health Departments in this area, particularly that of North Dakota, have been pioneering in this latter type of sewage disposal because of effectiveness of treatment and low per capita costs. This method, apparently, is reasonable enough for even the smallest communities to afford. The larger communities must evaluate the cost of land as against installation and operation of conventional treatment. The North Dakota Health Department is now recognizing lagoon treatment as a reasonable solution to stream pollution in North Dakota except for possibly the larger cities in the State.

Benefits to increased low flow regulation are generally based on the savings resulting from a lower degree of sewage treatment, generally primary treatment as compared to secondary treatment, but occasionally secondary as compared to tertiary treatment. Increments of flow that will not permit a change in

degree of treatment cannot be readily evaluated on a dollar basis. Also, where lagoon treatment is practicable, and acceptable to the State Health Department, dollar benefits based on increased flow is not possible since the waste is economically treated and removed essentially from the water-course.

Water Supplies

Benefits to water supplies show considerable promise. A review by the State Health Departments of existing water supplies in this region indicates that of 41 public systems, 18 have water of unsatisfactory chemical quality, thirty-one are shown as having adequate quantity as present, 9 are inadequate, while the adequacy of 1 is unknown. Future (1975) estimates indicate that 16 supplies will be adequate, 14 inadequate, 5 doubtful and future adequacy of 6 is unknown. With increasing industrial activity and new industries related to the land resource development, adequate water supplies will increase in value. It is anticipated by the Bureau of Reclamation that most communities within the region will have dairy plants, shipping and produce stations, or potato processing plants. The Bureau also estimates that industries with independent water supplies in the Minot-Velva, Devils Lake, Jamestown and Towner Areas will require 4,591 million gallons annually (table 2). The probable type of industry in the Towner Area is indicated as a sugar refinery.

Table 2. ESTIMATED INDUSTRIAL WATER REQUIREMENTS*
GARRISON DIVERSION UNIT
(For industries with independent supply systems)

<u>General Location</u>	<u>Probable Type</u>	<u>Annual Requirement</u>	
		<u>Million gallons</u>	<u>Acre-feet</u>
Minot-Velva Area	Not determined	2190	6720
Devils Lake Area	" "	1095	3360
Jamestown Area	" "	730	2240
Towner Area	Sugar refinery	<u>576</u>	<u>1770</u>
	Total	4591	14,090

*Data Supplied by Bureau of Reclamation.

The Missouri-Souris Projects Office of the Bureau of Reclamation is making costs evaluations for the towns that may benefit from improved water supplies to determine if it may be more economical to take their supply from the Garrison Diversion Unit or from an alternate source.

Missouri River Basin

Three small communities - Coleharbor, Turtle Lake, and Underwood - in the watershed of the Missouri River may be affected by the Garrison Diversion Unit. This region is sparse in good water supplies and benefits may accrue to both municipal and industrial water uses. Present sewage treatment is adequate. No benefits will accrue to the development program from improved stream sanitation in this area.

Souris River Basin

Velva Canal will originate from Lonetree Reservoir and convey water to the irrigable lands lying within the loop of the Souris River adjacent to the eastern arm of the loop. Natural water flow in the western arm will not be influenced by the development program. Referring to table 1 of this report and tables S-10 and S-18 of the Missouri-Souris Development Area Water Pollution Investigation (November, 1951) it will be noted that in the vicinity of Velva, low flow will increase from zero to 1 c.f.s. At Towner, low flows will be increased from zero to 151 c.f.s. in summer and to 31 c.f.s. in

winter. A continuous flow of 20 c.f.s. will be discharged in the Souris River bed to Canada.

The Souris Basin is an area deficient in waters of good quality and of adequate supply. The Bureau of Reclamation forecasts considerable growth associated with development of the land and water resources. The ultimate population of Minot is estimated at nearly 70,000; Velva at nearly 3,000, and Towner also about 3,000. In addition, the food processing industry is expected to increase substantially. Industries of undetermined types with independent supply systems in the Minot-Velva Area are expected to require annually 2,190 million gallons of water (table 2). A sugar refinery will probably locate in the Towner Area and require 576 million gallons of water annually. The availability of water from the Garrison Diversion Unit should prove valuable to supplement the water supplies of municipalities and industries.

Since flow routing will have, at most, only minor effect on stream flow at Minot and Velva, no benefits will accrue to the development program at these locations for improved stream sanitation.

Velva and Towner will probably ultimately provide lagoon sewage treatment. The possible Sugar Refinery at Towner, operating seasonally from October to January may produce wastes equivalent to a population of 80,000 people. Proposed flows of the Development Unit during the winter - 31 c.f.s. (table 1) - at Towner will necessitate an extremely high degree of treatment,

probably lagooning. Adequate stream flow for dilution of primary treated effluent under ice cover will exceed 300 c.f.s. Under the conditions indicated, no benefits will accrue to the Development Program for stream sanitation in the Towner reach of the Souris River.

Devils Lake Area

The community of Devils Lake will increase in population and industry. In addition, industries of non-determined types are expected to develop in the region and require 1,095 million gallons of water annually. It is speculatively estimated that these latter industries may discharge wastes with an ultimate population equivalent of 50,000. Discharge of wastes to lakes must provide at least for removal of settleable material and floating solids and exclusion of toxic materials. These requirements will not change with the development program. Also, to conserve the recreational potential of the lakes, the North Dakota State Health Department may stipulate lagooning to provide essentially complete treatment. No benefits may accrue to the program for stream sanitation in this area.

Red River of the North Basin

Flow in the Sheyenne River will be increased by the development program. The New Rockford, Devils Lake, Warwick and Baldhill Canals feed areas within the Sheyenne Drainage Area. The Wild Rice River of North Dakota will probably have greater

minimum sustained flows resulting from the Oakes Development. Improvements in flows will exist in the Red River from the cumulative effects of return flows and other excess waters. Reference is made to table 1 of this report and tables R-10, R-18, and R-19, of the Missouri-Souris Development Area Water Pollution Investigation.

Much irrigable lands lie in this basin and modification of the development plan may provide early delivery of water. The effect of return flows from these lands upon the Red River must be evaluated when plans are crystallized.

The Red River Basin water supply quality is generally satisfactory. Most supplies are adequate for current use but present a problem regarding future adequacy particularly if the development program results in the anticipated population and industrial growth. The value of a supplemental water supply for potential future growth should be great.

The North Dakota State Health Department is recommending lagoon sewage treatment for communities in the Sheyenne Valley. With complete removal of wastes from streams by communities, no cost benefits will accrue to the development program for supplemental stream flow in the upper reaches of the Sheyenne River.

In the lower reaches of the Sheyenne River and below the Fargo-Moorhead area on the Red River low stream flow supplements may prove beneficial. Low flows in the Sheyenne River at West Fargo will be increased both summer and winter. However, table R-19 indicates the future desirable stream flow at this location after primary treatment of sewage to be 330 c.f.s. in

summer and 600 c.f.s. in winter; secondary treatment flows are indicated as 90 c.f.s. in summer and 180 in winter.

Flow routing will provide, in the lower Sheyenne, flows less than that specified for future secondary treatment during the winter time, a critical period for maintenance of dissolved oxygen. Thus, a sewage treatment plant must have installed capacity and facilities for a high degree of treatment during the winter time. Since the facilities must be installed, regulated flows during the rest of the year cannot be given full credit for a lower permissible degree of treatment during these high flow times. A savings in operation is a distinct possibility. Another consideration might be normal secondary treatment during the major portion of the year with part of the sewage treated by lagooning during the winter low flow months.

The benefit of low flow supplementation in the Sheyenne River at West Fargo is based upon future growth of population and industry anticipated by the Bureau of Reclamation and on estimated pollution increase of double the existing load. The flows anticipated as a result of the Garrison Diversion Unit and given in column 2, table 3, is assigned a future benefit of \$50,000 annually.

Similar reasoning applies to the Red River reach below the Fargo-Moorhead Area. Flows in column 4, table 3, as anticipated from the development program, will have an assigned annual future benefit of \$70,000.

Table 3. Flows by Months for Critical Locations in the
Red River Basin

Month	<u>West Fargo</u>		<u>Fargo-Moorhead</u>		<u>Greater Grand Forks</u>	
	Future* Desirable Secondary Treatment Flows (1)	Garrison** Diversion Unit Flows (2)	Future* Desirable Secondary Treatment Flows (3)	Garrison** Diversion Unit Flows (4)	Future* Desirable Secondary Treatment Flows (5)	Garrison** Diversion Unit Flows (6)
Jan	180	106	420	124	530	145
Feb	180	104	420	123	530	119
March	100	103	200	161	260	118
April	40	563	60	755	80	1429
May	60	257	70	313	90	622
June	90	241	130	317	170	440
July	90	224	130	321	170	395
Aug	90	332	130	441	170	464
Sept	90	258	130	349	170	361
Oct	40	1160	60	1221	90	1223
Nov	40	962	60	976	90	994
Dec	180	137	420	164	530	171

*From Table R-19, Missouri-Souris Development Area Water Pollution Investigations.

**From Bureau of Reclamation

Below Greater Grand Forks, low mean monthly flows expected once in 5 years during the summer is 390 c.f.s. and once in ten years is 150 c.f.s. The comparable winter flows are 200 c.f.s. and 100 c.f.s. respectively. Since these summer flows approach that required for satisfactory dilution of secondary sewage treatment and low flow supplementation during the winter is much below that needed, no benefits may be assigned to the proposed flows at the Greater Grand Forks region.

The State Health Department recommends lagoon treatment of municipal wastes in the Wild Rice River Sub-Basin. No benefit is anticipated from increased sustained flows in this river.

James River Basin

The upper reaches of the James River Basin will be serviced by the Sykeston and New Rockford Canals. Water from the latter canal will supplement return and natural flows in the James River. Flows in the James will be regulated from the existing Jamestown Dam.

The Bureau of Reclamation estimates that Jamestown may have an ultimate population of over 30,000 and considerable expansion in industry. In addition, the Bureau estimates that unspecified industries in the Jamestown area will require annually 730 million gallons of water (table 2).

Municipal water supplies appear to be more adequate in this basin than in the Souris and Red River regions. Yet, water

quality in some instances is unsatisfactory and adequacy for future demands uncertain. A firm water supply of good quality would be of value. Referring to table 16, James River Drainage Basin Water Pollution Report, it is apparent that natural flow in the James frequently approaches, if not actually reaches, zero. Sustained flows in the James resulting from the development program will have considerable value for future development.

Sewage treatment in this area will probably tend towards lagooning of wastes. Since the James River Basin water pollution survey in 1951, Jamestown, North Dakota, has installed lagoon treatment with excellent results. The State Health Departments of both North Dakota and South Dakota look with favor upon this economical treatment method.

The flows in the James River resulting from the development program will be inadequate during the winter months except where a high degree of sewage treatment is practiced. Ultimate future benefits for flows indicated in columns 2 and 4, table 4, are assigned a value of \$60,000 annually for the Jamestown-Aberdeen reach of the James River.

Table 4. Flows by Months for Critical Locations in the
James River Basin

Month	<u>Jamestown</u>		<u>Aberdeen, Oakes</u>	
	Future* Desirable Secondary Treatment Flows (1)	Garrison** Diversion Unit Flows (2)	Future* Desirable Secondary Treatment Flows (3)	Garrison** Diversion Unit Flows (4)
Jan	70	27	90	27
Feb	70	29	90	28
Mar	70	32	90	32
April	25	50	25	50
May	30	323	30	311
June	40	282	45	284
July	40	260	45	238
Aug	40	484	45	445
Sept	40	480	45	446
Oct	30	117	30	117
Nov	25	39	25	39
Dec	70	38	90	38

* From Table 27 - James River Drainage Basin Water Pollution Report.

** From Bureau of Reclamation.

Summary

The development of land and water resources in the Souris, Sheyenne, Red, and James River Basins is now being based largely on water importation from the Missouri River by the Garrison Diversion Unit. A revaluation of the effect of the development program, as influenced by the Garrison Diversion Unit, upon stream flow and stream sanitation was made. Consideration has been given to progress in sewage treatment methods. Future benefits were based upon population and industrial growth forecast by the Bureau of Reclamation. Future annual benefits have been estimated as follows:

River Reach	With Stream Flows as Anticipated from the Development Program.
Souris River	\$ 0
Sheyenne River-West Fargo	\$50,000
Red River-Fargo-Moorhead	\$70,000
Wild Rice River	\$ 0
James River-Jamestown-Aberdeen	\$60,000

Flow revision, as may be necessitated by changes in the development program, will require further study and evaluation.